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ABSTRACT

Middle school mathematics teachers universally rely on the content of textbooks for the content of their instruction. However, in recent years it has become apparent that dependence on textbooks in mathematics education is simply not effective. This paper discusses strategies that can help teachers use textbooks as resources upon which they can build. Topics discussed include textbook use in middle school classrooms, adjusting for class diversity, getting students' attention, making the numbers meaningful, encouraging classroom discussion, developing personal meaning, and finding alternatives to textbooks. (JRH)

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ED 401 102

Overcoming the Limitations of Mathematics Textbooks in the Middle School Classroom

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Middle school mathematics teachers universally rely on the content of textbooks for the content of their instruction. But are textbooks the most appropriate sources of mathematics content for today's students? Studies, such as those reported by Tyson and Woodward in 1989, have found that even though math textbooks have a pervasive influence over middle school education, the characteristics of textbooks and their supplementary materials lend to a variety of problems. If used incorrectly, the rigid time schedules and lesson plans that accompany many textbooks can actually determine the exact material that will be taught in a classroom, to whom it will be presented, and the ways in which it will be introduced.

In recent years, it has become apparent that dependence on textbooks in mathematics education is simply not effective. Efficient teachers who recognize the diversity in their classes modify the resources which textbooks offer in order to meet specific needs. They then focus on finding ways to get a student's attention and keep it long enough to teach new mathematical concepts. Expanded background information is then offered, as well as an explanation that goes beyond basic textbook content in order to further each student's understanding. By encouraging classroom discussion, teachers help students to develop personal meaning in difficult math concepts. Finally, by promoting a sense of imagination and discovery within students using math skills, teachers can help them to see that mathematics is not confined to the pages of a textbook. None of these objectives can be accomplished using math textbooks in isolation. Alternatives to the basic textbook, such as children's literature, can be used to help attain this goal. It is a fact that textbooks play a major role in classrooms today. Educators can not view these books as a master to be followed, but instead as a resource from which to build upon (Haylock, 1991, p. 44).

Textbook Use in Middle School Classrooms

Although many believe that this increased use of textbook content is threatening the quality of children's mathematics education, others hold that this is simply a myth. Sosniak and Stodolsky (1993), writing in the Elementary School Journal, state that the "influence of textbooks on classroom instruction and teachers' thinking [is] somewhat less than the literature would have us suspect" (p. 249). They explain that the conditions under which teachers work encourage, if not force, "selective and variable use of textbook material" (p. 249). The authors view teachers more as "gatekeepers" who must make individual decisions on which parts of a textbook to use and how to use them (p.251). Sosniak and Stodolsky go on to explain that "such decisions may or may not lead to close adherence to textbook content" (p. 251).

Ideally, perhaps, teachers would act as "policy brokers" selecting only the most important and necessary information from the math textbook (Sosniak and Stodolsky, 1993, p. 251). According to some estimates, however, this does not appear to be the case. Several authorities reported that between 67 to 90 percent of all classroom instruction in any subject and at any level consists solely of textbook applications (Muth and Alvermann 1992; Tyson and Woodward 1989; Woodward and Elliot 1990). They go on to report that mathematics classes claim the top end of this scale with textbook use at almost 90 percent (Weiss 1987). Much of the research that has been conducted has demonstrated the pervasive, and almost invasive, presence that textbooks hold in middle school classrooms and especially mathematics classes (Muth and Alvermann, 1992, p. 92).

Adjusting for Class Diversity

It is a fact that not every class is a mirror image of every other. The only rule that will hold from room to room is that students, as a whole, will have a wide range of

ability. These ability levels cannot be predetermined for every class in each city or region. As maintained by Derek Haylock (1991), the publishers of mathematical textbooks do not enter every classroom (p.44). They are not aware of the special problems or exceptional abilities of certain students in a class. It is absurd to believe that the words and problems presented in a textbook are going to be the best method of instruction for every student (Haylock, 1991, p. 44). Because instructors work with individual groups of students on a daily basis, they have the ability to adjust to the diverse learning styles that are present in the classroom, as well as any special difficulties with other academic material. A student who has difficulty even reading the textbook is certainly not going to find the concepts it contains any easier. Obviously, if textbooks are followed too closely and allowed to determine the direction and speed of the class, someone will be left behind. One book cannot work as a recipe to fix every student's problem or difficulty. Textbooks simply cannot be used without teacher support for students. Whether students are excelling in academic subjects such as math, or having problems such as reading, writing, or simply a lack of confidence, no one textbook is going to offer the information that they individually need. Instead, it becomes the responsibility of the teachers to take the concepts that students need to learn and present them in a way that can be understood by everyone.

Getting Students' Attention

It would be wonderful to have the luxury of believing that every student, in every classroom, in every middle school will have an unquenchable desire to learn the fundamentals of mathematics. Unfortunately, this is simply a dream. So how is the dilemma of the need to learn math and many students' aversion or simple avoidance to it solved? The instructors are forced to grasp students' attention by whatever means necessary. It must be noted that this is not a simple task in a world of ever-increasing

technology. Today, students expect to be dazzled in the classroom in the same ways that they are by television and video games. Unfortunately, within the confines of a school, stuntmen become a bit expensive and no villain can be massacred only to appear just around the next corner. There are many options from which to choose when trying to determine how to capture a class's attention. Only one of these includes textbooks. They appear to offer the needed material, with a few exceptions. What does a school book contain that will hold the attention of a child who is ten or twelve years old for the amount of time required to learn difficult concepts, some of which they have never seen before? While the pictures and graphics used in these textbooks are often colorful and sometimes eye catching, too often they have almost nothing to do with the material itself. Even though they may interest a student for a limited time, these images do not focus a student's attention on essential concepts. Why would a child choose to spend time looking at a textbook page full of colorful numbers when they could be playing with an interactive game which they control?

Making the Numbers Meaningful

Mathematical concepts and ideas cannot be deciphered or shared unless there is a basis on which to build this knowledge. An algebra equation cannot be manipulated unless addition, subtraction, multiplication, and division have been mastered. Similarly, the method used in division cannot be taught without subtraction, and that used in multiplication without addition, and so on. If background information is not provided to students, they will be lost when trying to conquer new skills. Textbooks are not autonomous and cannot be used in isolation. In order for students to attack the new ideas of a math text, the information in the book must be meaningful. According to one author, students show "remarkable progress ...once they understand the meaning, the language, symbols, and the inter-connections among the words [and] topics" in

mathematics (Seshan, paragraph1). The language and vocabulary used in mathematics are key to understanding its concepts. Griffiths and Clyne (1994) point out that " the language used in mathematics, and in particular the language encountered in the mathematics classrooms, is distinctly different from the everyday language of children and adults" (p. 10). The math curriculum introduces completely new words, as well as familiar words with completely new meanings. Children find learning the language of math a difficult task, and therefor, learning math concepts difficult, for two reasons. First, the nature of the mathematics register is "dense and precise" (Griffiths and Clyne, 1994, p. 10). Each word and symbol is important and carries its own individual meaning. The fact is that mathematics is vocabulary intensive. What may appear to be a rather simple inequality, may become much more complicated when the true meaning of the symbols is discussed. The second reason that mastering the language of mathematics is difficult is due to the ways in which the vocabulary has been traditionally taught. Through the years, the traditional methods have "ensured that many children see mathematics as the manipulations of symbols and formulas, and the language of mathematics as difficult, irrelevant and meaningless" (Griffiths and Clyne, 1994, p.11). Practices such as introducing vocabulary outside of any meaningful context, as well as restricting students opportunities to explore "both the mathematical concepts and the ways they can be expressed" have created an environment of frustration in the math classroom (Griffiths and Clyne, 1994, p.11). If students cannot read and comprehend the material in the textbook, and then understand a teacher's explanation, they will completely miss the ideas being presented.

Encouraging Classroom Discussion

Generally, mathematics instructors have agreed "that discussion - both between pupils and between teachers and pupils - is an important component of good mathematics teaching" (Haylock, 1991, p. 46). Ideas and concepts are only solidified in the brain

when they are used continuously. What better way is there to communicate and remember ideas than to share them with others? According to Haylock (1991), in attempting to "articulate their mathematical ideas, children clarify their concepts and gain mastery of the language patterns of mathematics" (p. 47). If teachers do not deviate from a textbook's scheme, they often rely too heavily on methods such as individualized learning. Although on the surface it appears as if this would allow students to simply learn the material at their own pace, this is not generally the case. According to Derek Haylock (1991), this method only sacrifices teacher instruction and support, as well as classroom discussion. He maintains that individualized learning "is a major contributory factor in the lack of progress in mathematics of many children" (Haylock, 1991, p. 47). Often, when using this method, teachers have classes with a wide range of ability. Instead of allowing for a greater amount of time for personalized instruction for each student, this method tends to spread teachers resources extremely thin (Haylock, 1991, p.47). Haylock (1991) observes that students simply attempt many workbook pages or cards which contain many math problems, however, when a student needs help from the teacher they seem to be too busy helping other students (p. 46). Because each student in the class is working at a different pace, teachers cannot anticipate needed materials or background instruction (Haylock, 1991, p.46). This sacrifices all chances of having hands-on experience using math in real-life situations. The fundamental problem with the individualized learning approach is that it is assumed that the best medium of instruction is the written word as it appears in textbooks (Haylock, 1991, p. 46). This is a false assumption that many educators realized long ago. Most middle school math textbooks cover the basic concepts to which students need to be introduced, however they leave little time for error or explanation. If instructors use all of a textbook's resources, including teacher's manuals, audiovisual aids, manipulatives, workbooks, tests which accompany the text, as well as suggested lesson plans, they will most likely find that there is no time to be found for additional explanation. Often life in a classroom

does not go according to plan. Students get sick and miss school, class periods are preempted for other activities, or material simply takes a longer period of time to cover than was initially expected. If textbooks are adhered to without deviation, their rigid schedules will determine what and who will be taught. Middle school classrooms require a certain amount of flexibility that textbooks do not offer on their own.

Developing Personal Meaning

The ideas and concepts that make up mathematics are often complicated. Many times, they are made to appear much more difficult by the ways in which they are presented. It is true that textbooks hold a majority of the basic curriculum, and that teachers should expand on their content. It is also true that teachers can offer additional explanation as well as background information to help further their students understanding. Yet, if students are not shown and do not discover ways of remembering these large amounts of new information, all of this hard work will be useless. The true test is if students can use academic material in everyday life. One of the most basic strategies of remembering complicated concepts is to give them personal meaning. If a child sees no practical reason for using skills such as multiplying fractions, they will never use or remember the concept effectively. It is important that students are allowed time to discover ideas and methods on their own. After being introduced to the formal mathematical concepts of the curriculum, students need to be able to recall these facts and rules, and apply them in a variety of situations at a later date. Many times students will be required to adapt the material that they have learned to fit a particular situation. This sense of security in their own math skills can only be ensured through practice. Derek Haylock (1991), author of Teaching Mathematics to Low Attainers, 8-12, suggests a concept which he calls "adhocorithms" (p. 49). These are students' "own informal, *ad hoc* ways of dealing with calculations or problems" (p. 49). They offer students an

opportunity to see just how much intellectual power they can hold, especially when dealing with math (p. 49).

Finding Alternatives to Textbooks

Many tools can be used to relate mathematics to students' everyday lives, as well as to get their attention. Technological advances in computers have made them more accessible in the classroom than ever. New ways in which to use calculators in math classes have made manipulating old ideas a new and exciting experience. Perhaps one of the best ways to reach children has been overlooked for many years. Children's literature, including magazines, picture books, and prose, is a wonderful tool for communicating many ideas. According to David Whitin and Sandra Wilde (1995), "it is through stories that we make and share meaning," as well as the way that we come to "understand our world" (p. ix). Children's stories can be used as a magical tool to "undo [the] straitjacket as it appears in mathematics" (Whitin and Wilde, 1995, p. ix). No longer does mathematics have to appear as a looming monster that students feel they must fight. Instead, the same difficult concepts that are presented in each chapter of a math textbook are offered in more understandable and less intimidating ways in much of children's literature. Many children's books help "to portray mathematics as it really is: a tool for helping us tell the stories of our lives" (Whitin and Wilde, 1995, p. ix). Mathematics does not have to be taught in isolation from every other academic subject. Instead, the phrase "the whole is greater than the sum of the parts" should be followed (Welchmann-Tischler, 1992, p. 1). If an interdisciplinary approach is used, mathematics can lend insight into other subject areas such as science, history, and literature. In turn, these same subjects can strengthen and support ideas and concepts in math (Welchmann-Tischler, 1992, p. 1). Children's literature, in any of its various forms, can work as a

"springboard" to capture students' attention. It can then be used to lead the students in making "math connections" with real life (Welchmann-Tischler, 1992, p. 1).

Mathematics teachers are now being asked to work toward new goals and standards. Gone are the days of simply teaching with a piece of chalk and a blackboard. The needs of today's students demand much more than just basic textbook instruction from their teachers. Encouraging active participation in the classroom helps students to effectively learn new mathematical concepts in the middle school. By finding alternatives to classic methods of instruction, teachers can adapt to class diversity, grasp students' attention, and still make the new mathematical ideas meaningful. Time for actual instruction in the classroom is at a premium. It must be used efficiently and with great care. By using alternatives to mathematics textbooks such as children's literature, teachers can help students use ideas and numbers in math to gain their own powerful knowledge that can be used in today's world.

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